PAG Ltd.
565 Kingston Road
Raynes Park
London SW20 8SA

T +44 (0) 20 8543 3131
F +44 (0) 20 8540 4797
E email@paguk.com
www.paguk.com

Sales Office
T +44 (0) 20 8543 3131
F +44 (0) 20 8540 4116
E sales@paguk.com

Professional Broadcast Equipment

Quality Considerations Relating to Lithium-Ion Technology

Lithium-Ion technology, as used in rechargeable cells, possesses a fantastic power-to-weight ratio, and this makes it particularly attractive to our industry. It is for this reason that it is especially well suited to the latest portable broadcast equipment, because, while cameras have become more compact, the current required to power them has steadily increased. The expectations of the user to access this reserve of power safely, is behind many of the problems being experienced today.

In the 1970s and 1980s, cell manufacturers introduced commercial rechargeable cells based on metallic Lithium. Unfortunately, some of these batteries quickly earned a dubious reputation for safety.

Metallic Lithium in rechargeable batteries was replaced by Lithium kept in its ionic state. In this way most of the electrochemical benefits of Lithium-based cells can be reaped without the safety issues associated with the volatile pure metal.

In order to maintain safety, the present Lithium-Ion technology must still be treated responsibly and with respect. It appears that many users of this “safe” technology are being lulled into a false sense of security, for it is perfectly possible to implement this technology poorly, resulting in a potentially dangerous battery.

To this effect, and with past history behind it, the International Civil Aviation Organisation (ICAO) has introduced stringent regulations that preclude the transportation of Lithium-Ion batteries without a Manufacturer’s Air Transportation Certificate. The certificate attests that the product being transported meets those regulations (false declarations incur severe penalties).

Potential Dangers

Despite the aforementioned advances in electrochemical structure, Lithium-Ion batteries remain inherently intolerant of overcharge, over-discharge and high current abuse, and all reputable batteries contain electronic protection circuits that are designed to protect both the battery and the user if these conditions are brought about.

Overcharge

The target charging voltage of a Lithium-Ion cell is 4.2V +/- 0.05V per cell, and the protection circuits should prevent charging above the specified safe voltage. Consistent overcharging can cause the plating of metallic Lithium within the cell. Bringing metallic Lithium back into the equation will cause instability, especially if the cell is of lower manufactured quality, and especially if any moisture has been introduced inadvertently during the production stage.

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Over-discharge
Over discharging can cause copper plating that leads to internal shorting within the cell. The protection circuits should stop discharge well before the battery gets below 2.5V per cell. A well-designed battery would permanently disconnect if a voltage below 1.5V is observed by the protection circuit.

High current abuse
If the battery is discharged at an excessive rate, the excessive transition of Ions can bring about a breakdown in the crystalline-layered structure of the plates of a cobalt oxide Lithium-Ion cell. This can lead to a sudden rise in temperature that could possibly ignite the organic solvent of the electrolyte (which will not self extinguish).

Quality
Quality, branded cells are a vital prerequisite to the creation of a safe Lithium-Ion battery. Poor quality cells may develop internal shorts, or their electrolyte may be contaminated, giving rise to further problems. We are disappointed to note that such products are being imported to our market and branded as professional products.

A quality product, such as the PAG Lithium-Ion battery, is designed around safety protection at every level. As the electronic protection circuits are vital for the safe operation of a battery, it is essential that they, in turn, should be protected, as in fact they are in the PAG battery. The electrolyte is a highly corrosive and conductive organic solvent. If the electrolyte were to be liberated for whatever reason - perhaps as the result of impact or a manufacturing defect - it could easily prevent a poorly designed or uncoated protection circuit from operating properly, or indeed from operating at all. This in turn would leave a faulty or damaged Lithium-Ion battery in an unprotected and therefore extremely hazardous state. It should also be noted that electrolyte seepage between circuit areas that have an electrical potential between them can then result in a conductive path being built-up through the electrolyte, this can then lead to ignition.

The PAG battery is fitted with two protection circuits, each independent and each capable of disconnecting the battery. Each circuit protects the battery from over- or under-voltage, over-current and excessive temperature. Other manufacturers rely on a single protection circuit.

Using semiconductor devices that are rated up to 100V, the PAG battery is fitted with protection against charging from an unsuitable and inappropriate charger. Other manufacturers rely on their single protection circuit, usually with devices rated to only 25V or 30V.

The PAG battery will reject charge in temperature extremes. Other manufacturers have no such protection at all.

The PAG battery has its protection circuits coated with Parylene, the premier conformal coating, as proof against electrolyte leakage. Other manufacturers boards are not protected in this way.

Considering all the above, the PAG Lithium-Ion battery range is the safest and most reliable on the market.

It is essential that a Lithium-Ion battery is never opened or tampered with, and to prevent this, all PAG batteries are sealed and electronically tamper-protected.

A Final Word

If a Lithium-Ion battery cuts out, consider why this may have happened. Check the state of charge and the load applied. It is not good practice to draw high current over extended periods routinely.

Consider using more than one battery at a time to share the load. PAG now offers a system of linking batteries called PAGlink, which enables two, three, or up to eight batteries to be connected in parallel in order to extend run-time or share a higher load.

Operating a Lithium-Ion battery within its correct rating will enable the battery to achieve its expected cycle life and capacity.

If one manufacturer's battery will run a heavy load above its rating where another will not, this does not mean it is a "better product". Under these circumstances a battery that does not cut out may be poorly protected and this can be dangerous.

Whatever the subtleties of chemistry employed, all Lithium-Ion batteries remain similar in that they can be potentially dangerous or designed and manufactured to be safe. Our philosophy is to produce quality products with safety foremost, and in this respect we will not cut corners.

In Short

- PAG batteries are protected against overcharging.
- PAG batteries are protected against over-discharging.
- PAG batteries automatically revert to sleep mode during extended storage periods thereby protecting against deep discharge abuse. Many batteries that we have tested do not do this.
- PAG batteries are protected against excessive discharge rates and automatically self-recover.
- PAG batteries are automatically protected to inhibit operation when the active core is beyond the safe upper and lower temperature thresholds.
- The PAG battery protection circuits are themselves protected against inadvertent cell electrolyte leakage by means of Parylene conformal coating.
- PAG batteries are protected within a polycarbonate case that combines high structural strength and chemical resistance.
- PAG batteries are sealed and tamper-protected against unauthorised interference with their original quality build standard and safety.
- PAG products are supported by a Worldwide Authorised Dealer Network.
- PAG batteries are manufactured within the coveted International Standards Organisation ISO 9001:2008 quality standard, a procedure that assures strict quality control at every level.

David Hardy
Quality & Technical Director
PAG Ltd., London.